LPTM
laboratoire de physique théorique et modélisation

anr agence nationale de la recherche

M2 Internship proposal

Title: Introducing confirmation and in-group bias in opinion dynamics models

Abstract:

Nowadays, online social media are widely used as primary information channels and tools for social interaction. With their unprecedented speed of communication and sheer volume of exchanged data, they define a vast public arena with evolving rules of virtual interaction. These rules emerge from complex dynamics, blending individual motivations with rapidly advancing technology and economic constraints.

Decades of research in cognitive, social, and behavioral sciences have uncovered fundamental processes behind information processing and attitude formation, in particular the existence of *cognitive biases* that constrain the way in which an opinion forms and diffuses. For example, the *confirmation bias* describes the propensity of social actors to pay more attention to opinions that are already near to their own, while they disregard those which are very different, the *negativity bias,* describes an enhancement of attention towards information with negative content or tone and the *in-group bias* refers to the fact that social actors give more credit to information issued from members of their own group. While there is extensive empirical evidence for the effect of cognitive biases on the formation of the opinion of the individual, understanding their broader systemic impact in a networked society remains an open challenge.

On the other hand, a vast literature exists on opinion dynamics models, ranging from theoretical models explaining general properties of social opinion formation, to data-driven ones aimed at predicting or controlling specific systems. Theoretical models, based on complex dynamical systems, have successfully shown how simplified versions of common human interaction traits can lead to large-scale outcomes observed in real systems, such as consensus, polarization, or fragmentation [1,2].

However, these models are extremely stylized, and it is urgent to understand the effect of important widespread characteristics of real systems on the known results, so as to allow for comparison with empirical observations. A systematic work has been done in the recent years to incorporate these widespread characteristics to a particular class of opinion dynamics models, called *bounded confidence models* [3,4], which already integrate the notion of confirmation bias, by including heterogeneity in the agents' properties and in their interactions, correlations between the agent's intrinsic properties and its local connectivity, fuzziness in the agents' decisions, etc. [5-8].

During this internship the selected student will explore an agent-based model that incorporates the confirmation and the in-group bias along with the fuzziness in the choice of the discussion partners. After the determination of the model, informed by real world data, its dynamics will be explored by numerical simulations.

This internship is part of the ANR project ***From individual cognitive biases to collective drifts on on-line social networks***, ***(COBCOD)*** devoted to understand how cognitive biases are amplified and potentially altered through repeated online interactions. Specifically, we seek to identify the mechanisms driving the emergence of dynamic patterns unique to online environments and explore how these collective dynamics, in turn, influence individuals. A second objective of the project is to investigate strategies for mitigating these effects and test them through models and experiments.

To achieve these objectives, the COBCOD team counts on the expertise of its members (see https://iscpif.fr/cobcod/), which allows to implement multiple approaches. These include individual-based modeling, complex computer simulations using both standard and generative agent-based models (ABM and G-ABM) to study the effects of biased agents in online networks, theoretical analysis of emergent phenomena, large-scale social network data analysis, online experiments with volunteer users, and fully controlled laboratory experiments. The selected candidate will be fully integrated to the COBCOD team and will benefit of the multidisciplinary background of the project that will allow to enlarge her/his knowledge beyond the specific model developed by the student.

References

[1] *Statistical physics of social dynamics.* Castellano, C., Fortunato, S. & Loreto, V. Rev. Mod. Phys. **81,** p591, (2009).

[2] *Opinion Dynamics: Models, Extensions and External Effects*, Sîrbu, A., Loreto, V., Servedio, V. D. P. & Tria, in Participatory sensing, opinions and collective awareness. p363–401, Springer International Publishing, Cham, (2017).

[3] Deffuant, G., F. Amblard, G. Weisbuch, and T. Faure, *How can extremism prevail? A study based on the relative agreement interaction model.* 2002, J. Artif. Soc. Soc. Simul. 5, 4, paper 1.

[4] Hegselmann, R. & Krause, U. *Opinion dynamics and bounded confidence models, analysis, and simulation.* Journal of Artificial Societies and Social Simulation 5 (2002).
[5] *When open mindedness hinders consensus.* H Schawe, L Hernández; Scientific reports **10** (1), 8273, (2020).
[6] *Collective effects of the cost of opinion change.* H Schawe, L Hernández; Scientific Reports **10** (1), 13825, (2020).
[7] *When network bridges foster consensus. Bounded confidence models in networked societies.* H Schawe, S Fontaine, L Hernández, Physical Review Research **3** (2), 023208 (2021).
[8] *Phase coexistence in the fully heterogeneous Hegselmann–Krause opinion dynamics model.* Perrier, R., Schawe, H. & Hernández, L. Sci Rep **14**, 241 (2024).

Practical information:

Requirements: The candidate should be a registered student of a second year Master program in Physics, Applied Mathematics or Cognitive Science, with strong interest in interdisciplinary studies, extensive numerical simulations and data analysis, and a very good programming skills. Good knowledge of Dynamical Systems, Statistical Physics, Phase Transitions and Network theory, will be strong asset for the application.
Working conditions: This is a 4-month internship (possibility of extension to 6 months), the candidate will receive the legal stipend allowed to public institutions (~630€/month). The working place will be the Laboratoire de Physique Théorique et Modélisation (LPTM) UMR CNRS-CY Cergy-Paris University. 2 Av Adolphe Chauvin 95430, Cergy-Pontoise.
Starting date: as soon as possible from March 1st 2026.
Application process: the applicants must send to the contact email below the following documents: CV, detailed grades of M1, along with a certification of the already known grades for M2 and a recommendation letter of one professor or supervisor. Selection will be open until the position is filled.
Contact : Laura.Hernandez@cyu.fr
Plus d'informations : https://iscpif.fr/cobcod/